GRADE 12 DIPLOMA EXAMINATION

Physics 30

January 1992

Alberta
EDUCATION

GRADE 12 DIPLOMA EXAMINATION
PHYSICS 30

DESCRIPTION

Time allotted: 2½ hours

Total possible marks: 70

This is a **closed-book** examination consisting of **three** parts:

PART A has 42 multiple-choice questions each with a value of one mark.

PART B has seven numerical-response questions each with a value of one mark.

PART C has four written-response questions for a total of 21 marks.

A physics data booklet is provided for your reference.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

GENERAL INSTRUCTIONS

Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.

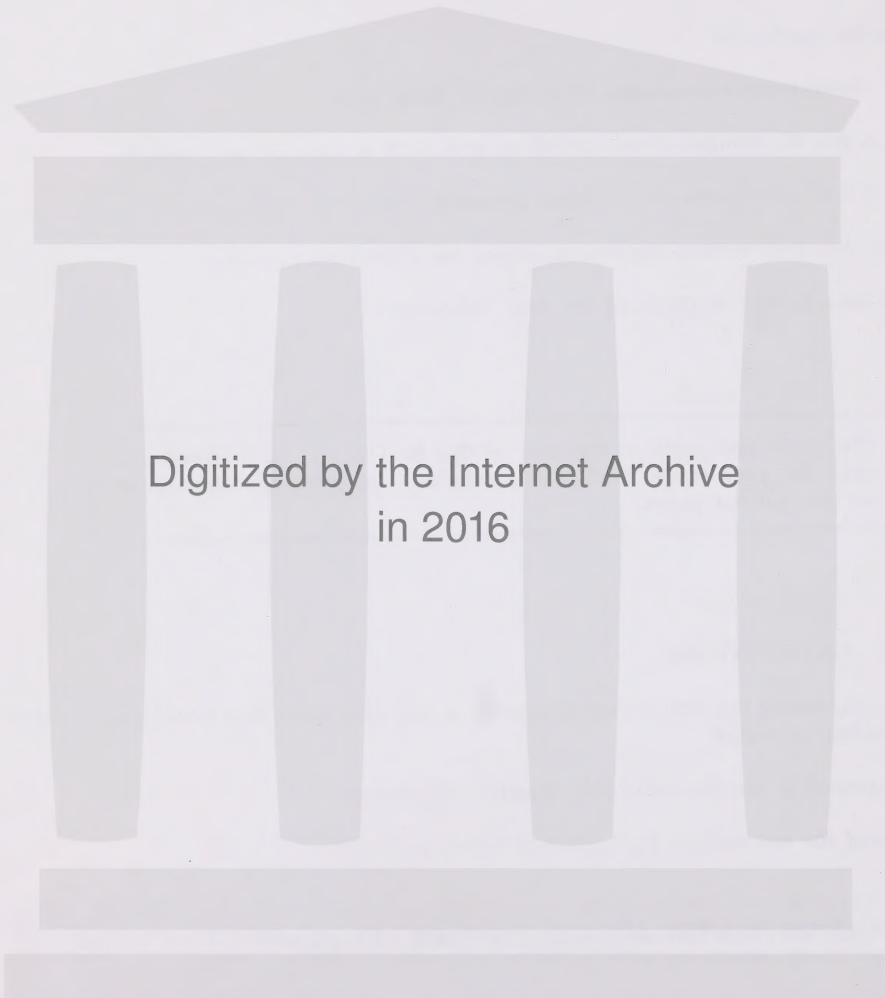
You are expected to provide your own scientific calculator.

Carefully read the instructions for each part before proceeding.

DO NOT FOLD EITHER THE ANSWER SHEET OR THE EXAMINATION BOOKLET.

The presiding examiner will collect your answer sheet and examination booklet and send them to Alberta Education.

JANUARY 1992



PART A

INSTRUCTIONS

In this part of the examination, there are 42 multiple-choice questions each with a value of one mark. All numbers used in the questions are to be considered as the result of a measurement.

Read each question carefully and decide which of the choices **best** completes the statement or answers the question. Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice. **Use an HB pencil only**.

Example **Answer Sheet**

This diploma examination is for the subject of Ⓐ ● Ⓒ Ⓓ

A. biology
B. physics
C. chemistry
D. mathematics

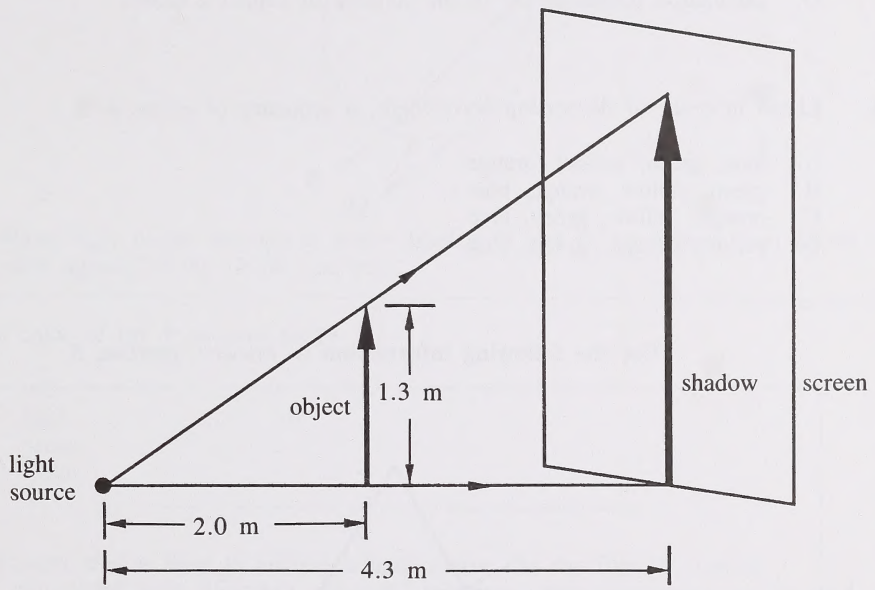
If you wish to change an answer, erase your first mark completely.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

DO NOT TURN THE PAGE TO START THE EXAMINATION UNTIL TOLD TO DO SO BY THE PRESIDING EXAMINER.

Use the following information to answer question 1.

A shadow of an object is formed by a point source of light.



An object that is 1.3 m high is 2.0 m from a point source of light. The object casts a shadow on a screen that is 4.3 m from the light source.

1. The height of the shadow is

A. 0.36 m
B. 1.5 m
C. 2.6 m
D. 2.8 m

---

2. An incident ray of light is initially normal to the surface of a plane mirror. In order for the angle between the incident ray and the reflected ray to be 40°, the mirror must be rotated through an angle of

A. 20°
B. 40°
C. 50°
D. 80°

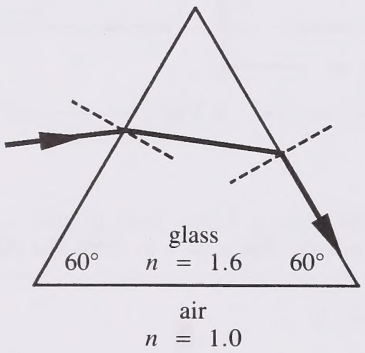
3. The most significant outcome of Römer's work with light was the

A. demonstration that light has a finite speed
B. calculation of an accurate value for the speed of light
C. demonstration that light is reflected from Jupiter's moons
D. calculation of the period of the eclipses of Jupiter's moons

4. Listed in order of decreasing wavelength, a sequence of colors is

A. blue, green, yellow, orange
B. green, yellow, orange, blue
C. orange, yellow, green, blue
D. yellow, orange, green, blue

Use the following information to answer question 5.

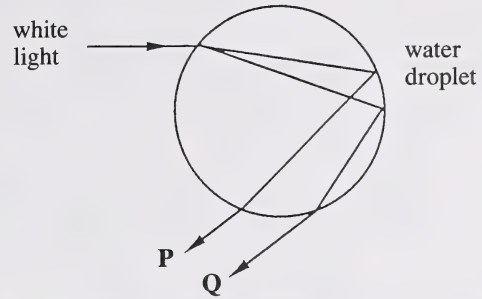


A ray of monochromatic light enters a glass prism and follows the path shown.

5. The angle of incidence at the first interface is

A. 13°
B. 21°
C. 36°
D. 39°

Use the following information to answer question 6.



White light passes through a water droplet. P and Q are typical rays in the outer regions of the visible spectrum.

6. The color of ray P is most likely

A. red
B. blue
C. green
D. white

---

7. A student uses a filter to analyse a light source. As the filter is rotated, the transmitted light alternately dims and brightens. This observation can be used as evidence to support the hypothesis that the light source

A. varies in color
B. is monochromatic
C. varies in intensity
D. is partially polarized

8. The wave model of light can explain all the following **except** the

A. reflection of light from a mirror
B. bending of light as it passes near the sun
C. refraction of light when it passes into a different medium
D. formation of dark and light bands that occur when light passes through a narrow slit

9. An electrically charged comb attracts small pieces of torn paper lying on a wooden desk because

A. the pieces of paper become charged
B. tearing the paper results in charge separation
C. the comb induces a charge separation in the paper
D. the polar molecules of the paper cause a redistribution of the charge on the comb

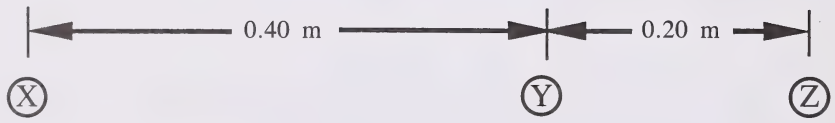
10. In a simple electric circuit, 1.6 J of energy are supplied to a lamp in 0.10 s. The charge transferred through the circuit is 0.20 C. The average current is

A. 0.50 A
B. 0.80 A
C. 1.2 A
D. 2.0 A

11. The force of repulsion between two unequal like charges is

A. directly proportional to the sum of the charges
B. directly proportional to the square of each charge
C. inversely proportional to the distance separating the charges
D. inversely proportional to the square of the distance separating the charges

Use the following information to answer question 12.



Charges X, Y, and Z have values of $+1.0 \times 10^{-5}$ C, $+5.0 \times 10^{-6}$ C, and $+1.0 \times 10^{-5}$ C respectively.

12. The net electrostatic force acting on Y because of X and Z is

A. 14 N to the left
B. 14 N to the right
C. 8.4 N to the left
D. 8.4 N to the right

---

13. A 1.0×10^{3} kg object weighs 1.04×10^{4} N on Saturn's surface. Given that the mass of Saturn is 5.77×10^{26} kg, the radius of Saturn is

A. 3.7×10^{15} m
B. 8.5×10^{7} m
C. 6.1×10^{7} m
D. 1.9×10^{6} m

14. Which of the following **cannot** be represented by a vector field?

A. The intensity of light near a light bulb
B. The Earth's gravitational influence on a small mass
C. The influence of a positively charged sphere on a proton
D. The magnetic field that surrounds a current-carrying wire

15. A device composed of successive layers of silver and zinc that are separated by pieces of moistened cardboard was first designed by

A. Ohm
B. Volta
C. Ampère
D. Faraday

16. The electron volt is a unit of

A. potential difference
B. current
C. energy
D. power

Use the following information to answer questions 17 and 18.

The formula for the resistance of a copper wire is

$$R = \rho L/A$$

where ρ = resistivity, L = length, and A = cross-section area

17. A wire that is 2.0 m long and 1.2×10^{-4} m in diameter has a resistance of 1.4 Ω. The numerical value in SI units for its resistivity is

A. 5.3×10^{-4}
B. 2.6×10^{-4}
C. 3.2×10^{-8}
D. 7.9×10^{-9}

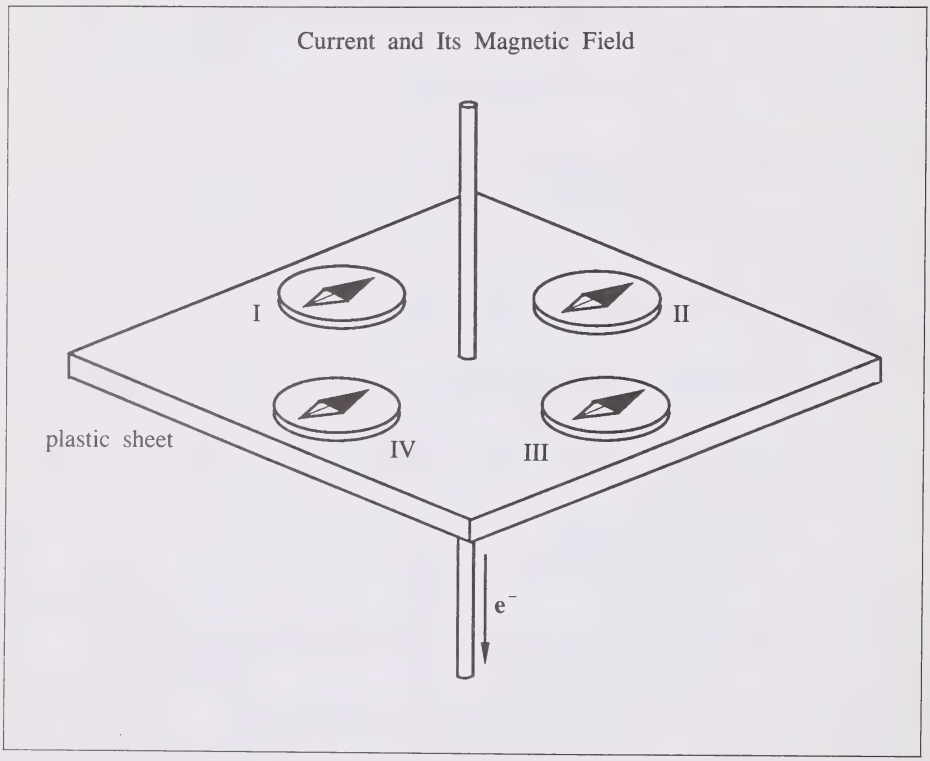
18. The SI unit for resistivity is

A. Ω
B. Ω•m
C. Ω/m
D. Ω/m^2

19. An electron travels due west at 2.5×10^{7} m/s through a magnetic field that has an intensity of 2.0×10^{-2} T. The direction of the field is due north. The resulting magnitude and direction of the force on the electron will be

A. 8.0×10^{-14} N upward
B. 8.0×10^{-14} N downward
C. 5.0×10^{5} N upward
D. 5.0×10^{5} N downward

Use the following information to answer question 20.



20. If the effects of the Earth's magnetic field are ignored, which compass needle is oriented correctly?

A. I
B. II
C. III
D. IV

21. According to Maxwell's assumptions, a changing electric field in space produces a

A. force
B. charge
C. magnetic field
D. radiation pressure

Use the following statements to answer question 22.

I. Electrons move from higher to lower energy levels in an atom.
II. High-speed electrons are suddenly stopped.
III. A charge oscillates.
IV. A radioactive element decays.

22. Which statements describe situations in which electromagnetic radiation may be generated?

A. I and II only
B. III and IV only
C. II, III, and IV only
D. I, II, III, and IV

---

23. At a given instant, the electric field of an electromagnetic wave points horizontally northward and the magnetic field points vertically upward. The direction the wave propagates is

A. horizontally eastward
B. horizontally southward
C. vertically upward
D. vertically downward

24. A garage door opener is designed so that it has an operational distance equal to 55 wavelengths. When the frequency is reduced from 205 MHz to 155 MHz, the **increase** in operational distance is

A. 26 m
B. 80 m
C. 110 m
D. 330 m

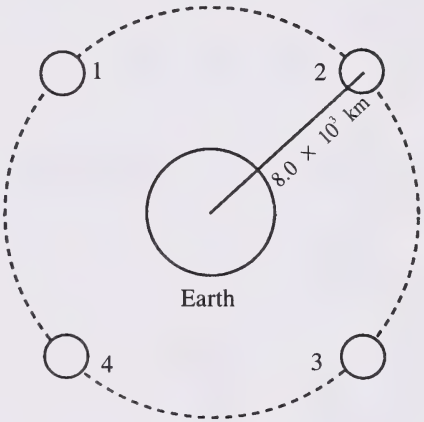
25. Hertz's induction coil produced electromagnetic radiation with a wavelength of approximately 1 m. This type of radiation is now called

A. X-ray
B. radio
C. infra-red
D. ultraviolet

26. An electromagnetic radiation of wavelength 2.7×10^{-14} m has a period of

A. 9.0×10^{-23} s
B. 4.5×10^{-13} s
C. 3.7×10^{13} s
D. 1.1×10^{22} s

Use the following information to answer question 27.



Four satellites are equally spaced in orbit in a single plane around the Earth at a distance of 8.0×10^3 km from the Earth's centre. Two radio signals are transmitted from satellite 1 to satellite 4. One signal takes a direct path; the other signal is transmitted via satellites 2 and 3 successively.

27. If the motion of the satellites is ignored, the time difference in the arrival of the two signals at satellite 4 is

A. 0.038 s
B. 0.075 s
C. 0.11 s
D. 0.15 s

28. The television signal reflected from a passing airplane interferes with the direct television signal, resulting in degraded picture and sound. Why are AM broadcast radio signals **not** affected by passing airplanes?

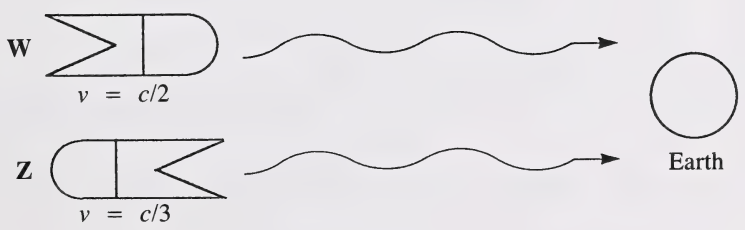
A. Broadcast radio waves refract and cannot reach airplanes.

B. Broadcast radio signals diffract around airplanes and do not reflect back to the ground.

C. Broadcast radio signals are absorbed by the metal skin of airplanes and are converted to heat.

D. Broadcast long-wavelength radio waves have the ability to penetrate and pass through the metal skin of airplanes.

Use the following information to answer question 29.



Two spaceships, W and Z, are three light-years away from Earth. Spaceship W is moving toward Earth at one-half the speed of light and spaceship Z is moving away from Earth at one-third the speed of light. As the spaceships pass each other, each sends a microwave signal to Earth.

29. The microwave signal from spaceship W will reach Earth

A. one and one-half years earlier than the signal from spaceship Z
B. two and one-half years earlier than the signal from spaceship Z
C. two-thirds of a year earlier than the signal from spaceship Z
D. at the same time as the signal from spaceship Z

30. The law of multiple proportions is most appropriately illustrated by the sequence

A. hydrogen ($^{1}_{1}H$), deuterium ($^{2}_{1}H$), tritium ($^{3}_{1}H$)
B. solid H_2O, liquid H_2O, gaseous H_2O
C. NO_2, SO_2, CO_2
D. N_2O, NO, NO_2

31. Element X has an atomic mass of 28 g/mol and a valence of 2. In an electrolytic cell, the time required for a current of 1.2 A to deposit 5.8 g of element X is

A. 3.0×10^{-5} s
B. 0.34 s
C. 2.9 s
D. 3.3×10^{4} s

32. Millikan determined the charge on an electron by balancing

A. electric and magnetic forces only
B. magnetic and gravitational forces only
C. electric and gravitational forces only
D. electric, gravitational, and magnetic forces

33. An observation supporting the hypothesis that cathode rays are charged particles is that

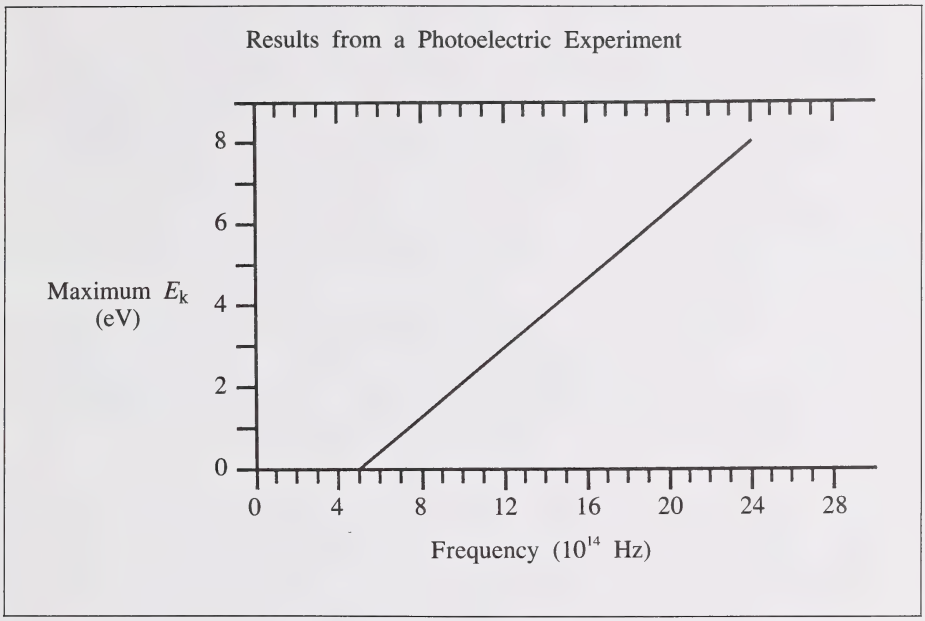
A. cathode rays can be bent by magnetic fields

B. cathode rays are observed only in tubes that contain low-pressure gases

C. when silver (Ag) salts are bombarded with cathode rays, the colors of the salts change

D. no matter what the cathode is made of, the cathode rays produced have the same characteristics

Use the following information to answer question 34.



34. The maximum kinetic energy of the photoelectrons that are emitted by light of wavelength 1.7×10^{-7} m is

A. 1.1 eV
B. 5.2 eV
C. 6.2 eV
D. 7.3 eV

---

35. To produce an X-ray of frequency 2.4×10^{17} Hz, an electron must have a speed of at least

A. 9.9×10^{3} m/s
B. 5.8×10^{6} m/s
C. 1.3×10^{7} m/s
D. 1.9×10^{7} m/s

36. Bohr's theory accounted very well for the spectra of atoms and ions with

A. one electron
B. two electrons
C. four electrons
D. eight electrons

Use the following information to answer question 37.

Some Energy Levels in a Hypothetical Atom

W _____ −0.01 eV

X _____ −2.01 eV

Y _____ −4.51 eV

Z _____ −12.0 eV

Note: These energy levels are not given to scale.

37. When the atom undergoes an electron transition from level W to level Y, the emitted photons have a wavelength of approximately

A. 8.9×10^{-8} m
B. 1.0×10^{-7} m
C. 2.8×10^{-7} m
D. 4.9×10^{-7} m

38. The scientist who developed a purely mathematical model of the atom and established what is now known as wave mechanics was

A. Bohr
B. de Broglie
C. Rutherford
D. Schrödinger

39. A photon of period 5.0×10^{-16} s has a momentum of

A. 1.3×10^{-18} kg•m/s
B. 4.4×10^{-27} kg•m/s
C. 3.3×10^{-48} kg•m/s
D. 1.1×10^{-57} kg•m/s

40. A photon of light that has a frequency of 6.00×10^{14} Hz has the same momentum as an electron. The speed of the electron is

A. 8.37×10^{2} m/s
B. 1.46×10^{3} m/s
C. 3.64×10^{3} m/s
D. 6.59×10^{3} m/s

41. The velocity of an electron can be measured with an uncertainty of 1.0×10^{-3} m/s. The minimum uncertainty of the position of the electron is

A. 8.6 m
B. 4.3 m
C. 0.73 m
D. 0.058 m

42. Einstein objected to the quantum mechanical model of the atom because it

A. was probabilistic rather than deterministic
B. supported Heisenberg's uncertainty principle
C. was not as useful a theory as classical mechanics
D. did not incorporate his work on the photoelectric effect

YOU HAVE NOW COMPLETED PART A. PROCEED DIRECTLY TO PART B.

PART B

INSTRUCTIONS

In this part of the examination, there are seven numerical-response questions each with a value of one mark. All numbers used in the questions are to be considered as the result of a measurement.

Read each question carefully.

Record your answer on the answer sheet provided by writing it in the boxes and filling in the corresponding circles.

Enter the first digit of your answer in the left-hand box and leave any unused boxes blank.

Use an HB pencil only.

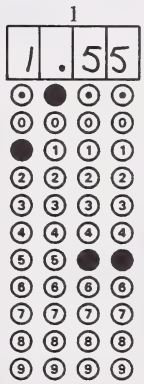
Sample Questions and Solutions **Answer Sheet**

1. If the angle of incidence in air is 47.4° and the angle of refraction is 28.3°, the index of refraction is _____ .
(Round and record your answer to three digits.)

$$n = \frac{\sin \theta_1}{\sin \theta_2}$$

$$n = \frac{\sin 47.4°}{\sin 28.3°} = 1.5526585$$

Record 1.55



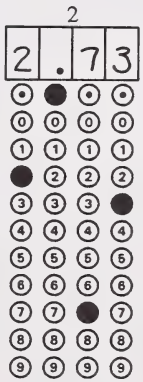
2. A microwave of wavelength 11.0 cm has a frequency of $b \times 10^9$ Hz. The value of b is _____ .
(Round and record your answer to three digits.)

$$f = c/\lambda$$

$$= (3.00 \times 10^8 \text{ m/s})/(0.11 \text{ m})$$

$$f = 2.727... \times 10^9 \text{ Hz}$$

Record 2.73



If you wish to change an answer, erase **all** traces of your first answer.

START PART B IMMEDIATELY.

1. When a light ray in air has an angle of incidence of 40.0° on a piece of glass that has an index of refraction of 1.50, the angle of refraction is _____ degrees. (Round and record your answer to three digits.)

2. Light of wavelength 5.73×10^{-7} m illuminates a double slit. On a screen 2.00 m away from the slit, an interference pattern is formed with fringes that are 4.12 mm apart. The distance between the slits, expressed in scientific notation, is $b \times 10^{-w}$ m. The value of b is _____ .
(Round and record your answer to three digits.)

3. Alpha particles, trapped by a magnetic field, are in an orbit of radius 4.36 cm. If the velocity of the particles is exactly doubled, the new radius will be _____ cm.
(Round and record your answer to three digits.)

4. At a certain separation, the force between two identical point charges is 2.16×10^{-3} N. If the charge on each point charge is doubled and the distance between the centres of the charges is doubled, the new force between the charges, expressed in scientific notation, will be $\boldsymbol{b} \times 10^{-3}$ N. The value of $\boldsymbol{b}$ is _____ .
(Round and record your answer to three digits.)

5. A microwave of frequency 3.89×10^{10} Hz has a wavelength in glass of 3.52 mm. The refractive index of glass for microwaves is _____ .
(Round and record your answer to three digits.)

6. In an electrolysis experiment, 4.02 g of an element are liberated. If the current is reduced to one-third of its original value and the cell is left to operate twice as long, the mass of the liberated element will be _____ g.
(Round and record your answer to three digits.)

7. A photon of blue light has a momentum of 1.52×10^{-27} kg•m/s. The energy of the blue photon, expressed in scientific notation, is $b \times 10^{-w}$ J. The value of b is _____ .
(Round and record your answer to three digits.)

YOU HAVE NOW COMPLETED PART B. PROCEED DIRECTLY TO PART C.

PART C

INSTRUCTIONS

In this part of the examination, there are four written-response questions for a total of 21 marks. All numbers used in the questions are to be considered as the result of a measurement.

Read each question carefully.

Write your answer in the examination booklet as neatly as possible.

For full marks, answers **must show all** pertinent explanations, calculations, and formulas.

All numerical answers must be given correct to the appropriate number of significant digits.

NOTE: The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.

START PART C IMMEDIATELY.

FOR DEPARTMENT USE ONLY

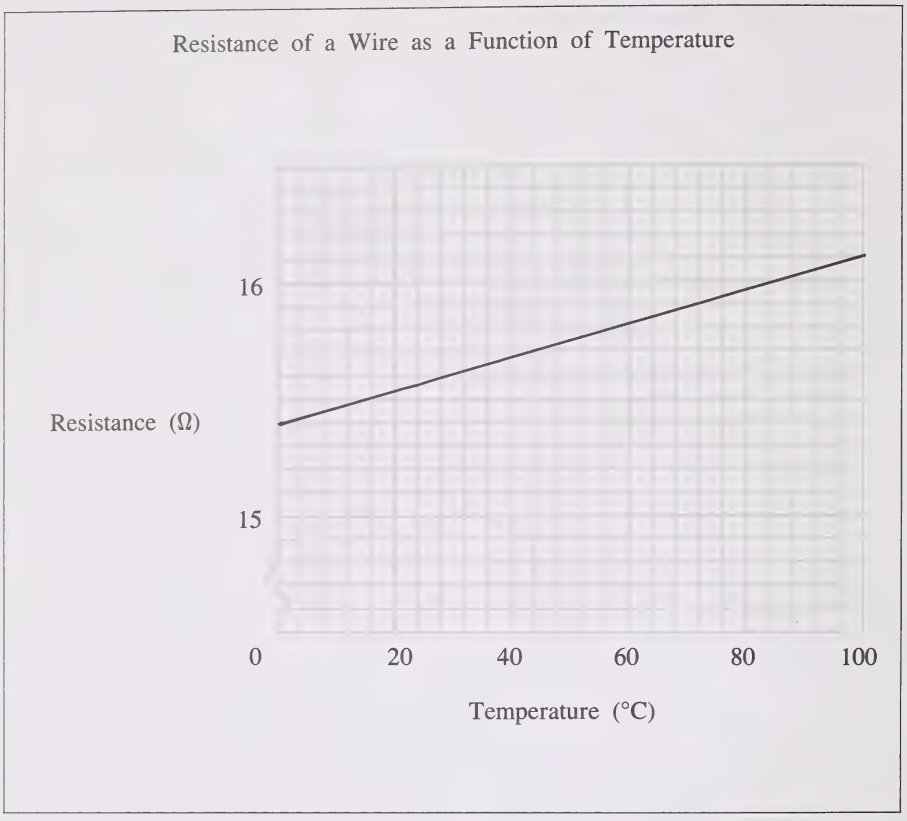
1. Calculate the kinetic energy and the de Broglie wavelength of an electron travelling at the relativistic speed of $0.800c$.

(5 marks)

FOR DEPARTMENT USE ONLY

(5 marks)

Use the following information to answer question 2.



2. a. Determine the change in the current flowing through the wire if the temperature rises from 24°C to 86°C while the voltage remains fixed at 145 V. Be sure to indicate whether the current increases or decreases. Express your answer to **two** significant digits.

FOR DEPARTMENT USE ONLY

b. The temperature coefficient of resistance α can be defined by the equation

$$R = R_0(1 + \alpha T)$$

where R_0 is the resistance at 0°C and T is the temperature in °C. Find α (magnitude and correct units) for the wire. Express your answer to **two** significant digits.

FOR DEPARTMENT USE ONLY

(6 marks)

3. A double slit has a slit separation of approximately 0.2 mm. The separation must be measured to an accuracy of ± 0.01 mm.

a. Outline the procedural steps you would take to make an indirect measurement of slit separation. List all equipment you would use and specify the relevant data you must collect in order to make the calculation. Note: A microscope cannot be part of the equipment you would use.

FOR DEPARTMENT USE ONLY

b. Give either an algebraic or a numerical example to show how the slit separation would be calculated from the measurements you made.

c. When making measurements, you encounter uncertainties. For your measurements, estimate these uncertainties and demonstrate or explain how they affected the uncertainty in the final calculated slit separation.

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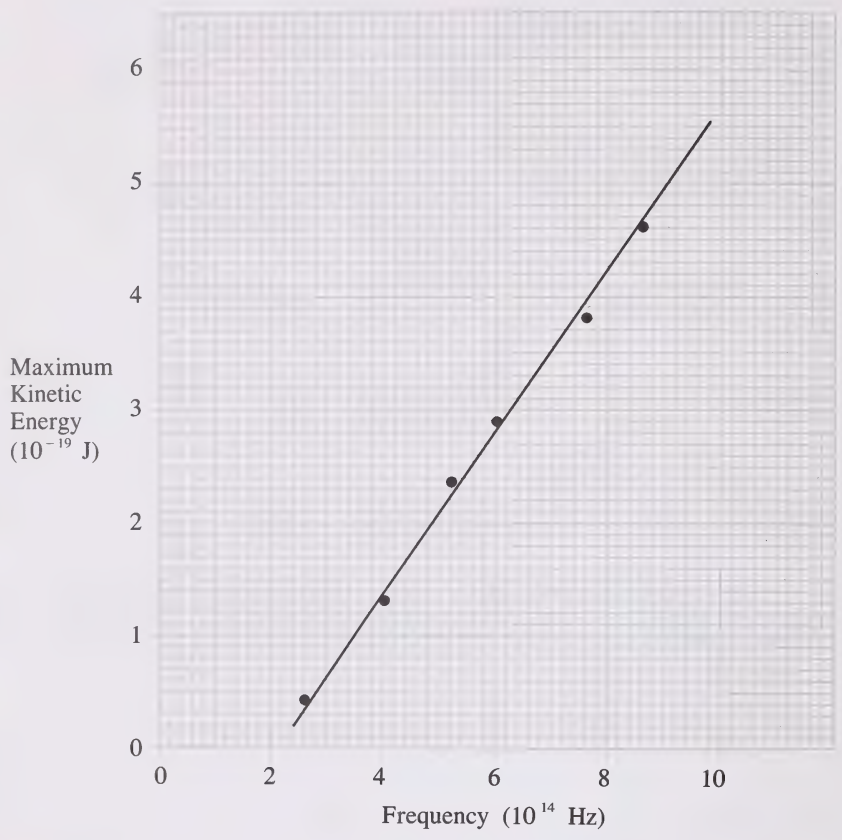
(5 marks)

Use the following information to answer question 4.



The maximum kinetic energy of the photoelectron is plotted as a function of the incident light frequency.

4. a. Calculate the slope of the graph.

FOR DEPARTMENT USE ONLY

b. Use the experimental results to estimate the maximum kinetic energy of the photoelectrons emitted by incident radiation of wavelength 2.7×10^{-7} m. Express your final answer to **two** significant digits.

YOU HAVE NOW COMPLETED THE EXAMINATION. IF YOU HAVE TIME, YOU MAY WISH TO GO BACK AND CHECK YOUR ANSWERS.

TEAR-OUT PAGE

(NO MARKS WILL BE GIVEN FOR WORK DONE ON THIS PAGE)

FOLD AND TEAR ALONG PERFORATION

TEAR-OUT PAGE

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FOLD AND TEAR ALONG PERFORATION

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M1 M2 M3 M4

APPLY LABEL WITHOUT STUDENT'S NAME

PHYSICS 30

NAME: (LAST NAME) (FIRST NAME) DATE OF BIRTH: Y M D SEX:

PERMANENT MAILING ADDRESS: (Apt./Street/Ave./P.O. Box) (Village/Town/City) (Postal Code)

SCHOOL CODE: SCHOOL: SIGNATURE:

PHYSICS 30
January 1992

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PHYSICS 30

PHYSICS 30 MULTIPLE-CHOICE KEY

1	D
2	A
3	A
4	C
5	C
6	A
7	D
8	B
9	C
10	D
11	D
12	C
13	C
14	A
15	B
16	C
17	D
18	B
19	A
20	deleted
21	C
22	D
23	A
24	A
25	B
26	A
27	B
28	B
29	D
30	D
31	D
32	C
33	A
34	B
35	D
36	A
37	C
38	D
39	B
40	B
41	D
42	A

PHYSICS 30 NUMERICAL RESPONSE KEY

1. 25.4
2. 2.78
3. 8.72
4. 2.16
5. 2.19

6. 2.68
7. 4.56

SAMPLE ANSWERS TO THE WRITTEN-RESPONSE SECTION

Note: **The responses that follow represent ONE approach to each of the problems. During the diploma examination marking session, provision is made for considering the various approaches students may have used.**

(5 marks) 1. Calculate the kinetic energy and the de Broglie wavelength of an electron travelling at the relativistic speed of $0.800c$.

$$m = m_0/\sqrt{1 - (v/c)^2}$$

$$= 9.11 \times 10^{-31}\ \text{kg}/\sqrt{1 - (0.800)^2}$$

$$m = 1.518 \times 10^{-30}\ \text{kg}$$

$$E_k = (m - m_0)c^2$$

$$= (15.18 - 9.11)(10^{-31}\ \text{kg})(9.00 \times 10^{16}\ \text{J/kg})$$

$$E_k = 5.46 \times 10^{-14}\ \text{J}$$

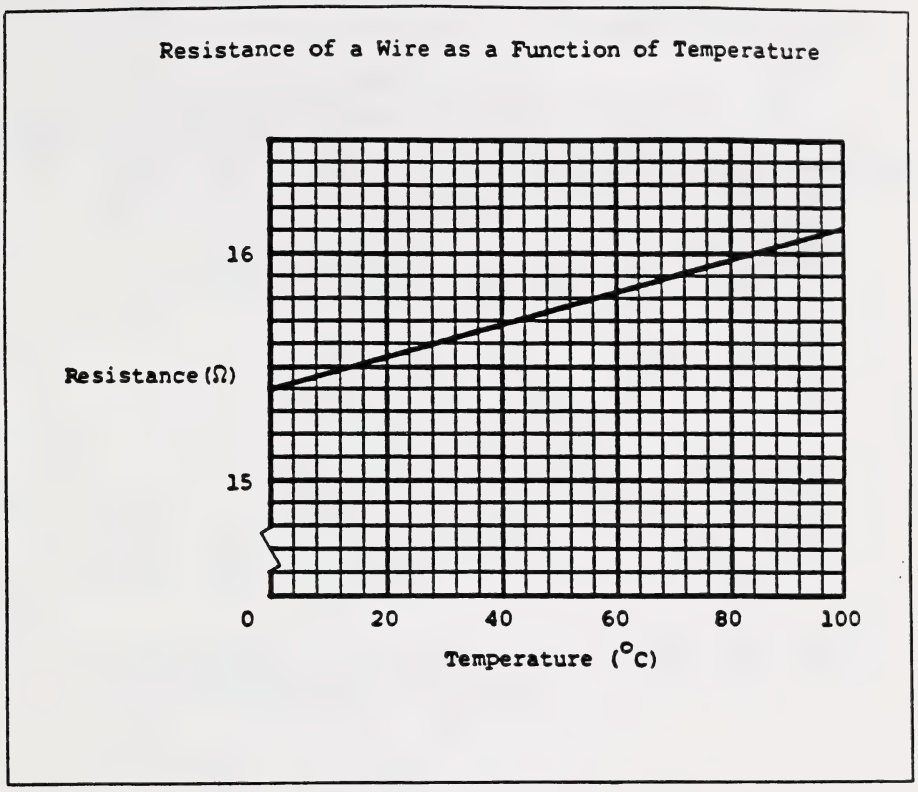
$$\lambda = h/(mv)$$

$$= 6.63 \times 10^{-34}\ \text{J}\cdot\text{s}/[(1.158 \times 10^{-30}\ \text{kg})(0.80)(3.00 \times 10^{8}\ \text{m/s})]$$

$$\lambda = 1.82 \times 10^{-12}\ \text{m}$$

Use the following information to answer question 2.

(5 marks)



2. a. Determine the change in the current flowing in the wire if the temperature changes from 24°C to 86°C while the voltage remains fixed at 145 V. Be certain to indicate whether the current increases or decreases. Express your answer to two significant digits.

At 24°C, $I_1 = V/R$

$= 145\ V/15.57\ \Omega$

$I_1 = 9.31\ A$

At 86°C, $I_2 = V/R$

$= 145\ V/16.02\ \Omega$

$I_2 = 9.05\ A$

$\Delta I = I_2 - I_1$

$= 9.05\ A - 9.31\ A$

$\Delta I = -0.26\ A$

b. The temperature coefficient of resistance α is defined by the equation

$$R = R_0(1 + \alpha T)$$

where R_0 is the resistance at 0°C. Find α (magnitude and correct units) for the wire. Express your answer to two significant digits.

$16.1\ \Omega = 15.4\ \Omega\ [1 + \alpha(98°C)]$

$\alpha = 4.6 \times 10^{-4}/°C$

(6 marks) 3. A double slit has a slit separation of approximately 0.2 mm. The separation must be measured to an accuracy of ±0.01 mm.

a. Outline the procedural steps you would take to make an indirect measurement of slit separation. List all equipment you would use and specify the relevant data you must collect in order to make the calculation. Note: You may not use a microscope as part of the equipment you would use.

light source of a known wavelength

ruler

screen

show the interference pattern on a blackboard

measure the distance from the slits to the blackboard

measure the distance from the central maximum to the first maximum

b. Show how the slit separation would be calculated from the measurements you made. (Give either an algebraic or a numerical example.)

$n\lambda = dx/l$

$d = \lambda nl/x$

Example:

$l = 4.0$ m

$\lambda = 7.0 \times 10^{-7}$ m

$x = 14.0$ mm

$n = 1$

$d = (7 \times 10^{-7}\ \text{m})(4.0\ \text{m})/(1.4 \times 10^{-2}\ \text{m})$

$d = 2.0 \times 10^{-4}\ \text{m} = 0.20$ mm

c. Whenever making measurements, uncertainties are encountered. For your measurement, estimate these uncertainties and demonstrate or explain how they affected the uncertainty in the final calculated slit separation.

Using a meter stick

Error in l is ±0.01 m

Error in x is ±0.002 m

Calculation

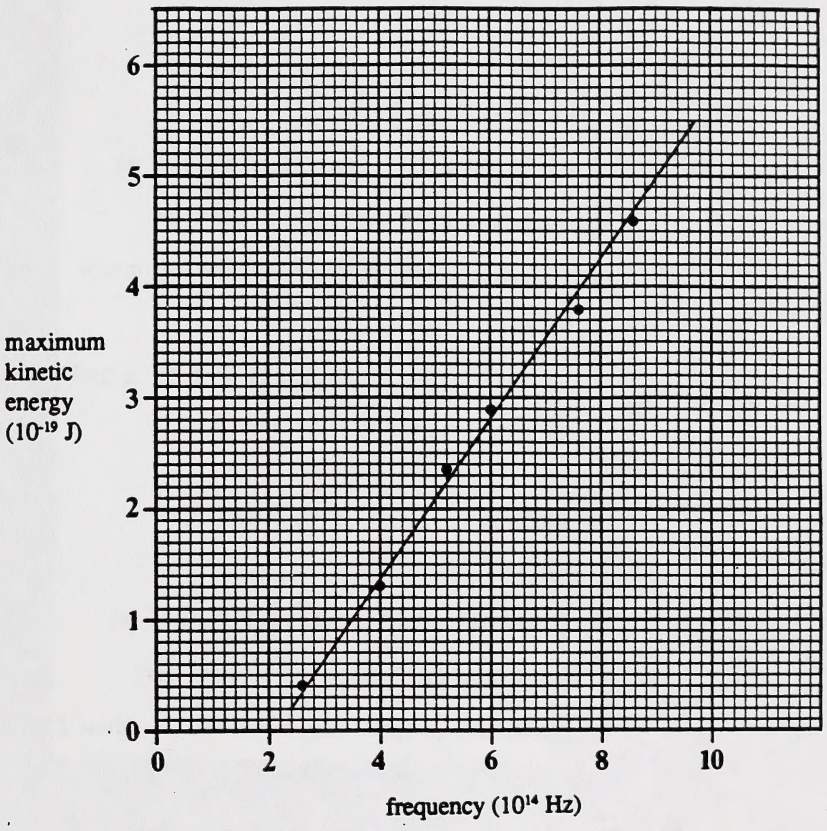
$$d = \frac{nl\lambda}{x} = \frac{(1)(4.01\text{ m})(7.0 \times 10^{-7}\text{ m})}{(0.016\text{ m})} = 0.18\text{ mm}$$

$$d = \frac{nl\lambda}{x} = \frac{(1)(3.99\text{ m})(7.0 \times 10^{-7}\text{ m})}{(0.012\text{ m})} = 0.23\text{ mm}$$

Results could vary from 0.18 mm to 0.23 mm

Use the following information to answer question 4.

Photoelectron Energy Data



The maximum kinetic energy of the photoelectrons is plotted as a function of the incident light frequency.

(5 marks) 4. a. Calculate the slope of the graph.

slope = rise/run = $\Delta E_k/\Delta f$

$$= \frac{(5.3 - 1.5)(10^{-19}\ \text{J})}{(9.4 - 4.2)(10^{14}\ \text{Hz})}$$

slope = 7.3×10^{-34} J•s or J/Hz

b. Use the experimental results to estimate the maximum kinetic energy of the photoelectrons emitted by incident radiation of wavelength 2.7×10^{-7} m. Express your final answer to two significant digits.

Method 1:

$f\lambda = c$

$f = c/\lambda$

$= (3.00 \times 10^{8} \text{ m/s})/(2.7 \times 10^{-7} \text{ m})$

$f = 1.1 \times 10^{15} \text{ Hz} = 11 \times 10^{14} \text{ Hz}$

$f_0 = 2.1 \times 10^{14}$ Hz from extending graph line

$E_k = h(f - f_0)$

$= (7.3 \times 10^{-34} \text{ J·s})[(11 - 2.1) \times 10^{14} \text{ Hz}]$

$E_k = 6.5 \times 10^{-19}$ J

Method 2:

$f = c/\lambda$

$= (3.00 \times 10^{8} \text{ m/s})/(2.7 \times 10^{-7} \text{ m})$

$f = 1.1 \times 10^{15} \text{ Hz} = 11 \times 10^{14} \text{ Hz}$

extend the graph line and read E_k when $f = 11 \times 10^{14}$ Hz

$E_k = 6.5 \times 10^{-19}$ J